

PB-230 018

REPORT FOR CONSULTATION ON THE
CHATTANOOGA INTERSTATE AIR QUALITY
CONTROL REGION (TENNESSEE-GEORGIA)

National Air Pollution Control Administration
Washington, D. C.

December 1969

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REPORT FOR CONSULTATION ON THE
CHATTANOOGA
INTERSTATE AIR QUALITY CONTROL REGION
(TENNESSEE-GEORGIA)

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Consumer Protection and Environmental Health Service
National Air Pollution Control Administration
December 1969

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PREFACE

The Air Quality Act of 1967 directs the Secretary of Health, Education, and Welfare to designate "air quality control regions" to provide a basis for the adoption of regional air quality standards and the implementation of those standards. The act stipulates that the designation of a region shall be preceded by consultation with appropriate State and local authorities. This report is intended to serve as background material for the consultation. It proposes boundaries for the Chattanooga Interstate Air Quality Control Region and discusses the factors which are the basis of the boundary proposal.

The Region* boundaries proposed in this report reflect consideration of available and pertinent information. However, the proposed boundaries remain subject to revisions suggested during consultation with State and local authorities. Formal designation of a Region will be made only after a careful review of all opinions and suggestions submitted during the consultation process.

The National Air Pollution Control Administration (NAPCA) appreciates assistance received from the State air pollution control programs of Tennessee, Georgia, and Alabama,

*For the purpose of this report, the word "region", when capitalized will refer to the Chattanooga Interstate Air Quality Control Region.

the Chattanooga-Hamilton County Air Pollution Control program, the Chattanooga Area Regional Council of Governments (CARCOG), and several State agencies and universities, all of which provided information for this study.

INTRODUCTION

THE REGIONAL APPROACH

Air pollution in the urban areas of the United States is a regional problem which frequently extends across State and local governmental boundaries. Since air pollution problems are rarely confined to any single municipality or county, successful control requires coordinated planning, standard setting, and enforcement by the several political jurisdictions which share a common problem. At the present State and local governments across the nation have only begun to develop a regional approach to air pollution control.

The Clean Air Act as amended provides a regional approach which depends upon coordination and cooperation between all levels of government; municipal, county, State, and Federal. To set in motion the machinery for regional air pollution control, the Department of Health, Education, and Welfare first designates air quality control regions, issues air quality criteria, and publishes reports on control techniques. The region designation indicates which State and local jurisdictions will be involved in a regional air pollution control effort. The air quality criteria indicate the extent to which various concentrations of an air pollutant are harmful to health and damaging to property. The reports on control techniques provide information on the costs and

effectiveness of various techniques for controlling air pollutant emissions.

After the Department of Health, Education, and Welfare completes these initial steps, State governments develop air quality standards and plans for implementation of those standards for portions of air quality control regions within their boundaries. An air quality standard defines the desired limit on the concentration of a pollutant in the ambient air of the region. It constitutes the degree of air quality which the regional control program will attempt to achieve. An implementation plan is a blueprint of the steps which will be taken to insure achievement of the air quality standards within a reasonable time. The Governors have 90 days to submit letters indicating that they intend to set standards, 180 days in addition to set the standards, and 180 days further to develop plans for implementing them. The procedure for setting standards includes a public hearing which allows residents of a region to express their views concerning desired standards.

The Department of Health, Education, and Welfare reviews air quality standards and implementation plans in order to ascertain their consistency with the provisions of the Clean Air Act as amended.

When air quality standards and implementation plans are approved, States proceed to prevent and control air pollution in accordance with those standards and plans. This system for establishing a regional approach to air pollution control is depicted in the flow diagram in Figure 1.

DESIGNATION OF AIR QUALITY CONTROL REGIONS

Designation of an air quality control region is one of the first steps in the regional approach to air pollution control. Section 107(a)(2) of the Clean Air Act as amended directs the Secretary, Department of Health, Education, and Welfare to make such designations. The portions of the section relevant to this discussion state:

"...The Secretary, after consultation with appropriate State and local authorities shall...designate air quality control regions based on jurisdictional boundaries, urban-industrial concentrations, and other factors including atmospheric areas necessary to provide adequate implementation of air quality standards. The Secretary may...revise the designation of such regions... The Secretary shall immediately notify the Governor or Governors of the affected State or States of such designation."

Procedure for Designation of Regions

Figure 2 illustrates the procedures used by the National Air Pollution Control Administration for designating air quality control regions.

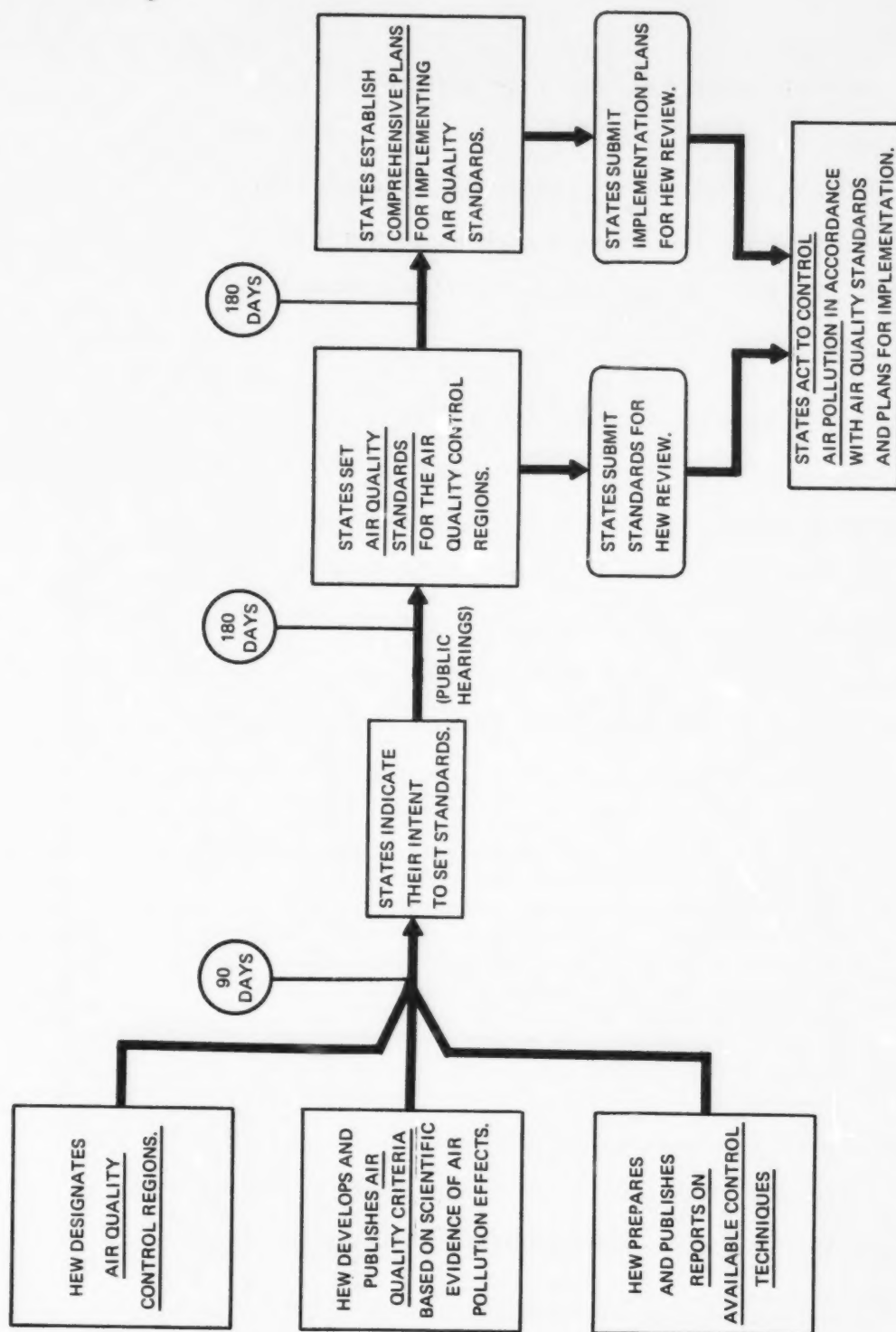


Figure 1 FLOW DIAGRAM FOR ACTION TO CONTROL AIR POLLUTION ON A REGIONAL BASIS, UNDER THE AIR QUALITY ACT.

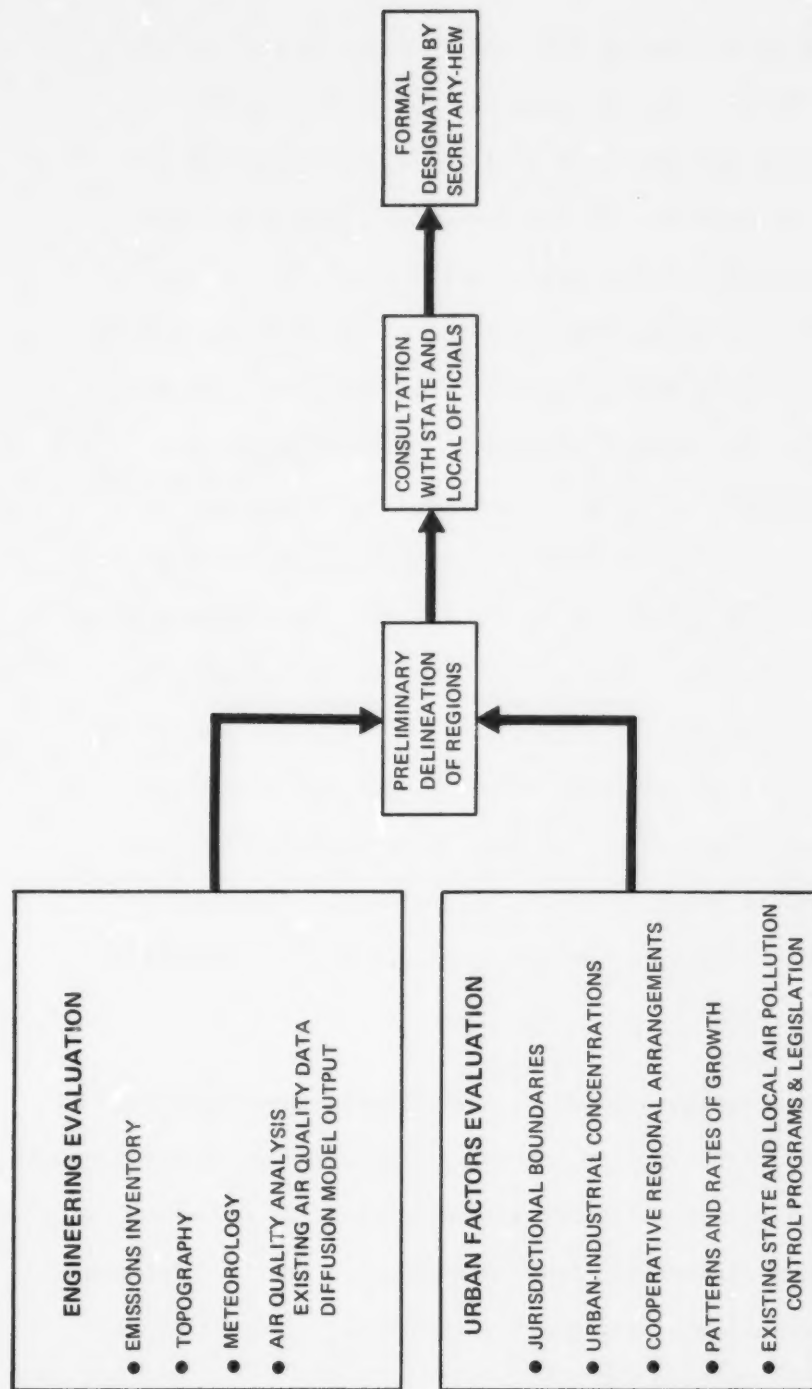


Figure 2. FLOW DIAGRAM FOR THE DESIGNATION OF AIR QUALITY CONTROL REGIONS.

After evaluating relevant engineering factors and urban factors, the National Air Pollution Control Administration publishes a proposed delineation of the region boundaries. At the same time NAPCA sets a time and place for a consultation meeting and distributes to State and local authorities a report of the evaluation study (such as this "Report for Consultation") which includes the boundary proposal. At the consultation meeting State and local authorities are encouraged to present fully their views and suggestions concerning the proposed boundaries of the region. Interested parties who do not have official status may submit comments in written form for the record. After careful review of all suggestions and opinions submitted for the record by interested parties, the Secretary of Health, Education, and Welfare makes a formal designation of the region boundaries and notifies the Governors of the designation.

The Size of a Region:

As stipulated in Section 107(a)(2), the designation of air quality control regions should be based on "jurisdictional boundaries, urban-industrial concentrations, and other factors including atmospheric areas necessary to provide adequate implementation of air quality standards." This language

suggests a number of objectives which are important in determining how large an air quality control region should be. Basically, these objectives can be divided into three separate categories.

First, a region should be self-contained with respect to air pollution sources and receptors. In other words, a region should include most of the important sources in the area as well as most of the people and property affected by those sources. In this way, all the major elements of the regional problem will lie within one unified administrative jurisdiction. Unfortunately, since air pollutants can travel long distances, it is impractical if not impossible to delineate regions which are completely self-contained. The air over a region will usually have at least trace amounts of pollutants from external sources. During episodic conditions, such contributions from external sources may even reach significant levels. Conversely, air pollution generated within a region and transported out of it can affect external receptors to some degree. It would be impractical and inefficient to make all air quality control regions large enough to encompass these low-level trace effects. The geographic extent of trace effects overestimates the true problem area which should be the focus of air pollution control efforts. Thus, the first objective,

that a region be self-contained, becomes a question of relative magnitude and frequency. The dividing line between "important influence" and "trace effect" will be a matter of judgment. The judgment should be based on estimates of the impact a source has upon a region, and the level of pollution to which receptors are subjected. In this respect, annual and seasonal data on pollutant emissions and ambient air concentrations are a better measure of relative influence than short term data on episodic conditions.

The second general objective requires that region boundaries be designed to meet not only present conditions but also future conditions. In other words, the region should include areas where industrial and residential expansion are likely to create air pollution problems in the foreseeable future. This objective requires careful consideration of existing metropolitan development plans, expected population growth, and projected industrial expansion. Such considerations should result in the designation of regions which will contain the sources and receptors of regional air pollution for a number of years to come. Of course, region boundaries need not be permanently fixed, once designated. Boundaries should be reviewed periodically and altered when changing conditions warrant readjustment.

The third objective is that region boundaries should be compatible with and even foster unified and cooperative governmental administration of the air resource throughout the region. Air pollution is a regional problem which often extends across several municipal, county, and even state boundaries. Clearly, the collaboration of several governmental jurisdictions is prerequisite to the solution of the problem. Therefore, the region should be delineated in a way which encourages regional cooperation among the various governmental bodies involved in air pollution control. In this regard, the existing pattern of governmental cooperation on the whole range of urban problems may become an important consideration. Certainly the pattern of cooperation among existing air pollution control programs is a relevant factor. In general, administrative considerations dictate that governmental jurisdictions should not be divided. Although it would be impractical to preserve State jurisdictions undivided, usually it is possible to preserve the unity of county governments by including or excluding them in their entirety. Occasionally, even this would be impractical due to a county's large size, wide variation in level of development, or striking topographical features.

To the extent that any two of the above three objectives lead to incompatible conclusions concerning region boundaries,

the region must represent a reasonable compromise. A region should represent the best way of satisfying the three objectives simultaneously.

As noted above, the evaluation of relevant engineering factors and urban factors forms the basis of the boundary proposals published by NAPCA. The evaluation of engineering factors is designed to indicate the location of pollution sources and the geographic extent of serious pollutant concentrations in the ambient air. Pollution sources are located by taking an inventory of emissions from automobiles, industrial activities, space heating, waste disposal, and other pollution generators. The transport and distribution of pollutants in the ambient air are analyzed on the basis of measured air quality data, the location of emissions, meteorological data, and topographic information. A mathematical diffusion model which predicts ambient pollution concentrations from information on emissions and meteorology can be used in areas where irregular topographical features would not invalidate the theoretical model. As a whole, the engineering study indicates how large the air quality control region must be in order to encompass most pollution sources and most people and property affected by those sources.

The study of urban factors encompasses a different set of considerations. It reviews existing governmental jurisdictions, the location of urban and industrial concentrations,

expected patterns of urban growth, cooperative regional arrangements, existing State and local air pollution control programs, and other associated factors. As a whole, the study of urban factors is designed to indicate how large a region must be in order to encompass expected regional growth and to encourage cooperation among political units in controlling air pollution.

The body of this report contains a proposal for the boundaries of the Chattanooga Interstate Air Quality Control Region and outlines the evaluation of engineering and urban factors which was the basis of the proposal. The report is intended to serve as the background document for the consultation with appropriate State and local authorities.

EVALUATION OF URBAN FACTORS

INTRODUCTION

A number of urban factors are relevant to the problem of defining air quality control region boundaries. First, the location of population is an important consideration, since human activity is the primary cause of air pollution, and humans are the ultimate victims. The population growth pattern is another important consideration, since an air quality control region should be designed not only for the present, but also for the future. The location of industrial activity and the industrial growth pattern are relevant considerations for similar reasons. Political and jurisdictional considerations are important, since the Clean Air Act envisions regional air pollution programs based on cooperative efforts among many political jurisdictions. The following discussion of urban factors will present these considerations as they apply to the Chattanooga area.

TOPOGRAPHY

Topography has been a dominant influence on the location of residential and industrial development in the Chattanooga area. Chattanooga lies at the southern end of man-made Chickamauga Lake, which is formed by the Tennessee River as it flows through the long valleys of the Cumberland Plateau

and the western Appalachian Mountains. Figure 3 displays the major valleys and ridges in the Chattanooga area. Walden Ridge and Sand Mountain form a natural barrier to the west of Chattanooga. Taylor Ridge and White Oak Mountain constitute a less pronounced but still significant barrier to the east. Lookout Mountain and Pigeon Mountain rise up south of Chattanooga. Except for a narrow breach in Walden Ridge cut by the Tennessee River, the water bodies, valleys, and ridges in the Chattanooga area are all aligned along an axis extending from the southwest to the northeast.

Interaction across ridge lines has been limited. Thus, Chattanooga has been relatively independent of development along the Sequatchie Valley in Jasper, South Pittsburgh, Bridgeport, and Stevenson. Likewise, growth in Dalton, Georgia, has not been influenced by close interaction with Chattanooga. The natural barriers created by the ridges are likely to influence the location of future development, just as they have influenced existing development. Therefore, the following review of population and industrial growth should be evaluated in terms of the topography of the area.

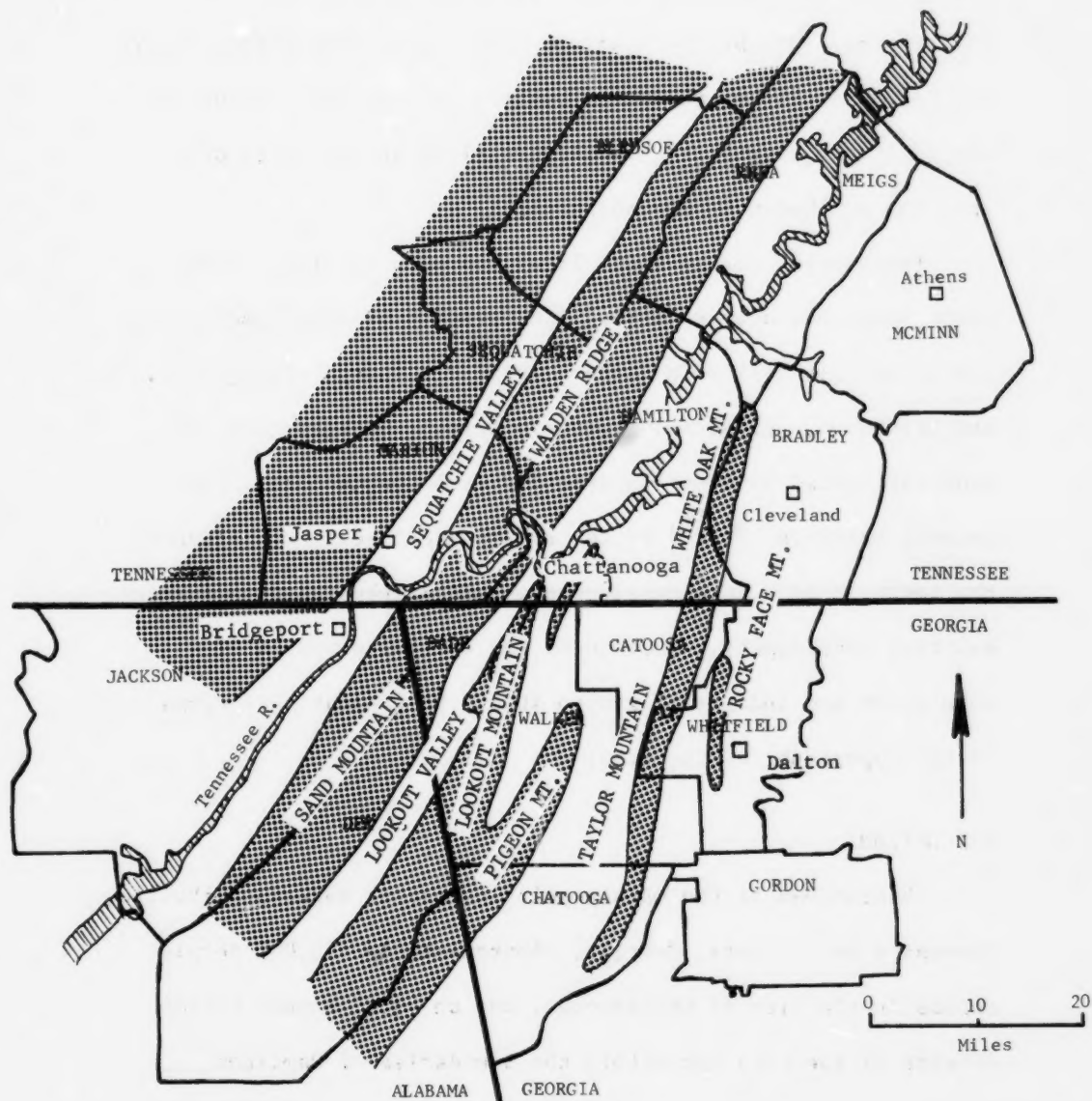
POPULATION

Chattanooga is the main population center between Nashville, Tennessee and Atlanta, Georgia. Approximately 125,000 people reside in the city of Chattanooga, and an equal number reside outside of the city but within the boundaries of Hamilton

Figure 3;

MAJOR VALLEYS AND RIDGES IN THE
CHATTANOOGA AREA

Ridge Areas:



County (see Table I). The next most populous county in the area is Walker, Georgia, which is situated directly adjacent to Chattanooga. Hamilton and Walker Counties constitute the Chattanooga Standard Metropolitan Statistical Area, as defined by the U. S. Census Bureau. Catoosa County, Georgia is also adjacent to Chattanooga, and both Walker and Catoosa contain major suburban areas such as Rossville, Lakeview, and Fort Oglethorpe. Hamilton, Walker, and Catoosa have a combined population of about 326,000 residents, and encompass all of the urbanized portions of Chattanooga.

Figure 4 displays the expected population density in 1970 of sixteen counties in the Chattanooga area. Hamilton County registers the highest density, with about 445 residents per square mile. Whitfield, Catoosa, Bradley, and Walker are the next most densely populated counties, with between 100 and 200 residents per square mile. However, Whitfield and Bradley have moderately high population densities not because of a close relationship with Chattanooga but because of their two central cities, Dalton and Cleveland. The remaining eleven counties in the area have relatively low population densities, each with less than 100 residents per square mile.

A number of separate organizations have studied the potential for population growth in the Chattanooga area during the next decade. Although the specific estimates of population growth vary from study to study, the data displayed in Table I and Figure 5 can be considered representative of the various

TABLE I
POPULATION ESTIMATES
1970 and 1980

<u>COUNTY</u>	<u>1970</u>	<u>POPULATION*</u>	<u>1980</u>
TENNESSEE			
Bledsoe	7,400		6,900
Bradley	48,000		57,700
Hamilton	245,100		248,100
McMinn	35,300		36,800
Marion	20,400		19,600
Meigs	5,100		5,100
Rhea	17,900		19,800
Sequatchie	6,500		7,000
GEORGIA			
Catoosa	29,000		33,000
Chattooga	19,000		25,000
Dade	9,500		14,000
Gordon	22,000		23,500
Walker	52,000		73,000
Whitfield	50,000		58,000
ALABAMA			
Dekalb	44,200		48,000
Jackson	40,000		44,000

*Sources: Tennessee State Planning Commission; The Georgia Department of Industry and Trade; The Georgia Social Sciences Advisory Committee; Alabama Social Sciences Advisory Committee; The Chattanooga Area Regional Council of Governments; and the University of Georgia

FIGURE 4: ESTIMATED POPULATION DENSITY, 1970.

Residents Per Square Mile

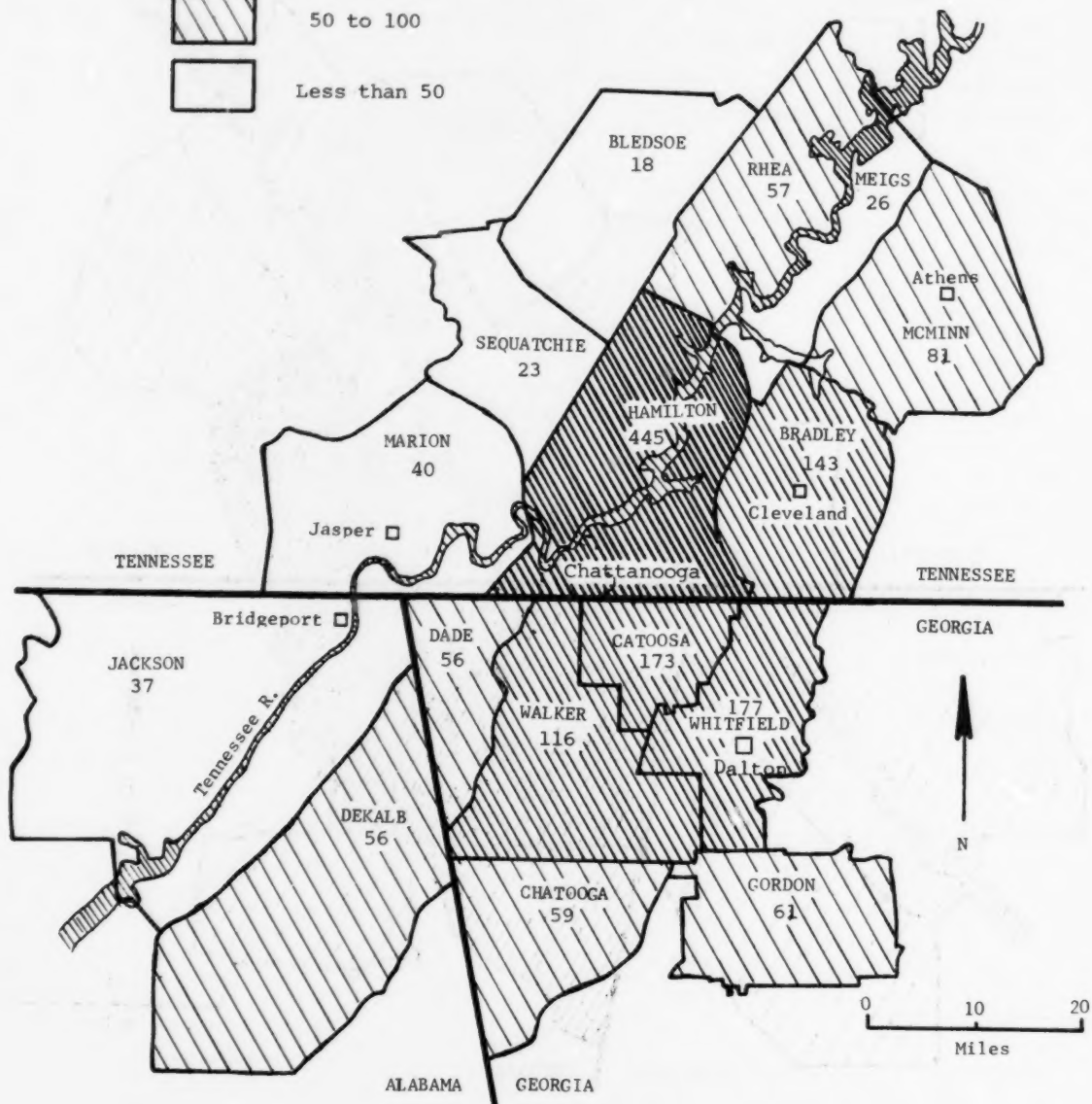
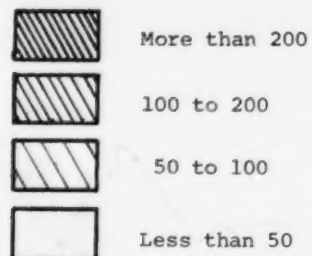
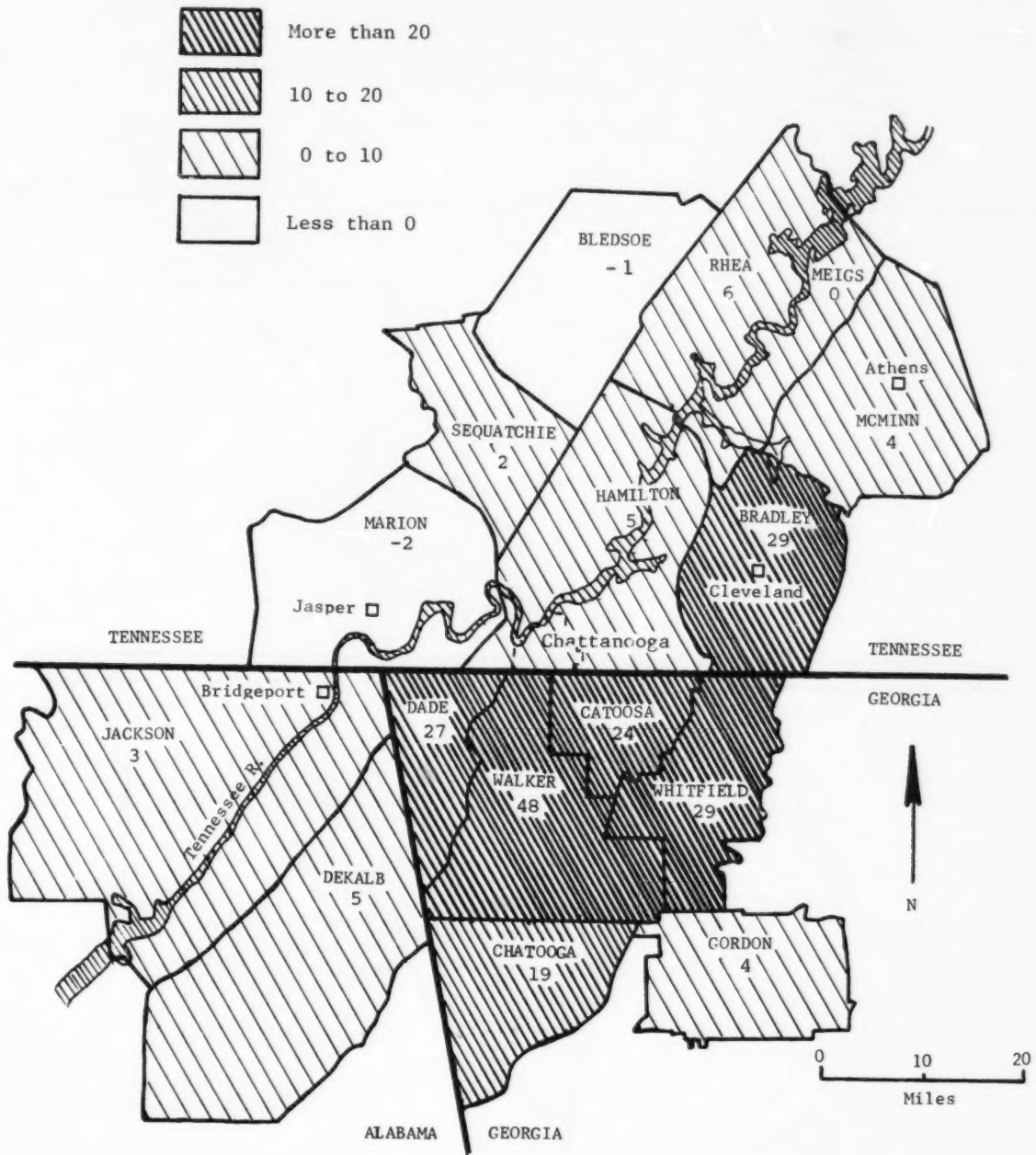


FIGURE 5: ESTIMATED POPULATION GROWTH, 1970 - 1980.

Additional Residents Per Square Mile



estimates. There appears to be general agreement that Walker County, Georgia will experience the most rapid growth, as a result of suburban development extending southward from Chattanooga. More than 20,000 additional residents are expected in Walker County by 1980. Catoosa and Dade Counties are also expected to be influenced by suburban development. Each county may have as many as 5,000 additional residents by 1980. On the other hand, the city of Chattanooga and Hamilton County are expected to record only a limited amount of growth. Bradley and Whitfield Counties each are expected to have 8,000 to 10,000 additional residents by 1980, but this population growth will be related to Dalton and Cleveland rather than to Chattanooga. Figure 5 illustrates the expected pattern of population growth in terms of additional residents per square mile.

In summary, Hamilton County contains the present center of urban development in the Chattanooga area. Walker and Catoosa Counties, which are situated adjacent to the city of Chattanooga, contain sizeable suburban developments. Although some neighboring counties have substantial numbers of residents, urban development in those counties is not linked to Chattanooga. Walker, Catoosa, and Dade Counties will contain the bulk of suburban growth expected to spread to the south of Chattanooga during the next decade.

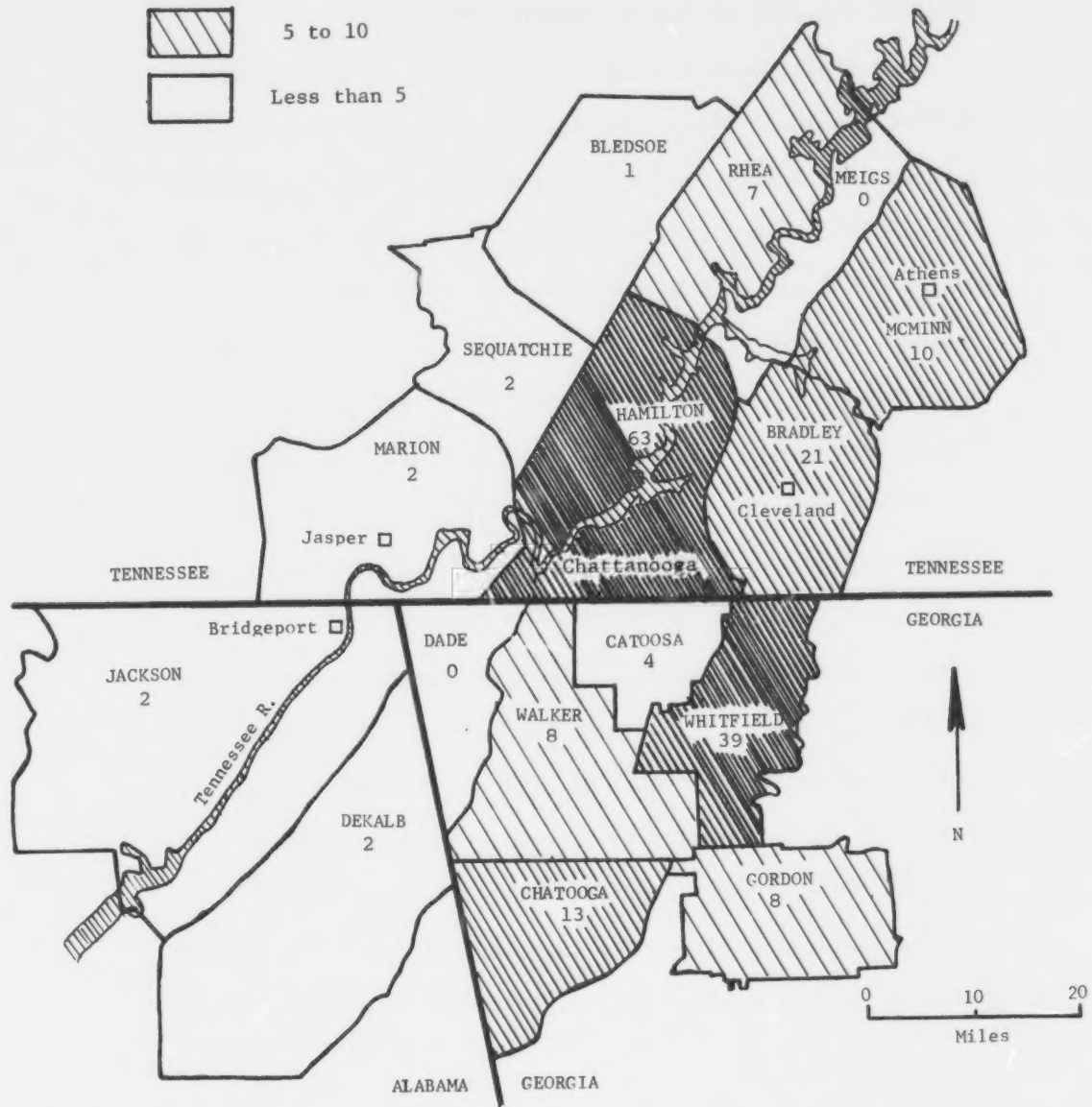
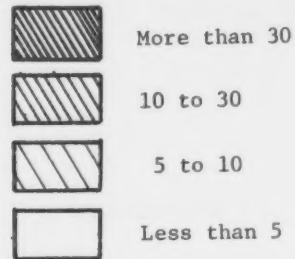
MANUFACTURING ACTIVITY

One method for determining the location of manufacturing activity is based on the number of people employed in manufacturing firms. Figure 6, which uses 1963 employment data, indicates the density of manufacturing employment on a county-wide scale. Hamilton County had by far the most dense concentration of manufacturing employment. Industries located in Hamilton County included primary and secondary metal products; ordnance production; stone, clay and glass products; textile products; lumber and wood products; leather products; chemical products; and pulp and paper products. Whitfield County had the next largest concentration of manufacturing employees. The primary category of industrial activity in Whitfield was textile products and carpets. Bradley County contained substantial manufacturing activities in textile and leather products, primary and secondary metals, pulp and paper products, lumber and wood products, and machinery. The remaining counties in the Chattanooga area had relatively low densities of manufacturing activity. In particular Walker and Catoosa Counties had very little industrial activity, despite their proximity to Chattanooga.

It is expected that industrial growth in the Chattanooga area will be attracted to the water and power resources of the Tennessee River. Thus, manufacturing growth linked to the

FIGURE 6: MANUFACTURING EMPLOYMENT DENSITY, 1963.

Employees Per Square Mile



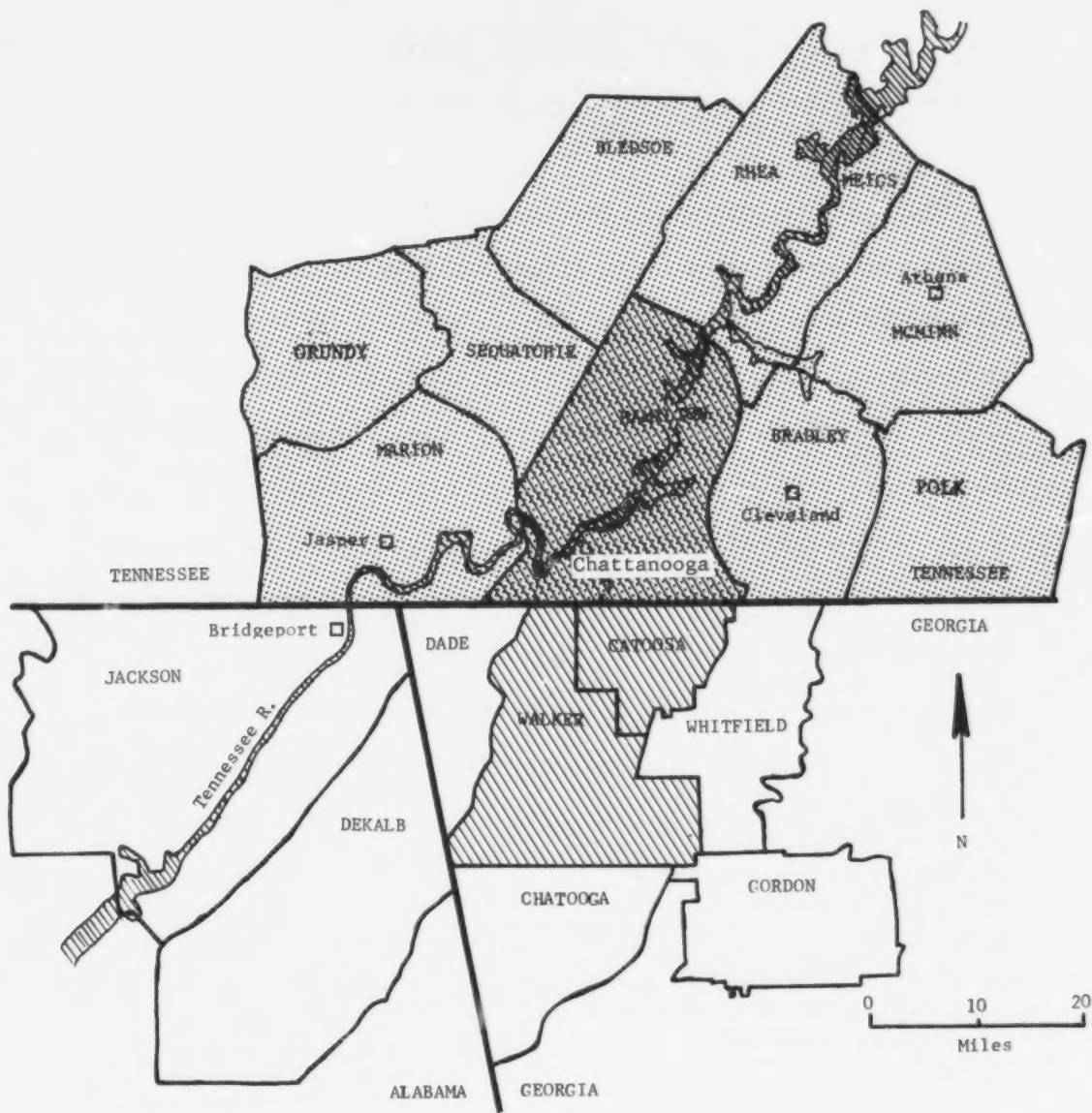
City of Chattanooga will probably be located in Hamilton County rather than Walker, Catoosa, or Dade. Industrial growth in Dalton and Cleveland is expected to occur independently of growth in Chattanooga.

REGIONAL PLANNING IN THE CHATTANOOGA AREA

The Chattanooga Area Regional Council of Governments (CARCOG) includes three counties; Hamilton, Walker, and Catoosa (See Figure 7). It was established as a non-profit corporation in 1967 pursuant to the "Interlocal Cooperation Act of 1967" of the State of Tennessee. The membership includes representatives from not only the county governments but also a number of city and municipal governments. Rather than employ a separate planning staff, the CARCOG has relied upon the planning staffs of the Chattanooga-Hamilton County Regional Planning Commission and of the Coosa Valley Area Planning and Development Commission. The Chattanooga-Hamilton County Commission has been responsible for planning activities within the City of Chattanooga and Hamilton County for a number of years. The Coosa Valley Commission has been responsible for planning activities throughout the twelve counties in the northwest corner of Georgia, including Walker and Catoosa Counties. The CARCOG budget jumped from about \$59,000 last year to about \$126,000

Figure 7:

REGIONAL PLANNING ORGANIZATIONS

Chattanooga Area Regional Council Of Governments: Southeast Tennessee Development District: 

this year. CARCOG is sponsoring a number of studies which have been completed or are in progress. They include a solid waste disposal study, a regional water and sewage plan, a park and recreational open space plan, a transportation study, an analysis of housing, and a generalized "regional sketch" plan. In addition, CARCOG carries out the responsibilities of Project Review under Section 204 of the Model Cities legislation.

The Southeast Tennessee Development District encompasses a ten county area, as shown in Figure 7. This District was established during 1968 by executive order of the Governor of Tennessee, pursuant to the "Economic Development District Act of 1965" of the State of Tennessee. The purposes of the District are to promote regional economic development and to provide a regional structure for coordinated planning and review of federal, state, and local assistance projects. Representation on the District Board includes not only county officials but also municipal and local agency officials. The District is funded by annual dues from each member county and by State and Federal grants. The current budget is about \$72,000. At the present time, the District staff is working on an "Overall Economic Development Plan" which will record and update the District's assets in terms of natural, human, and physical resources.

The Georgia-Tennessee Regional Health Commission was recently organized and will be responsible for comprehensive health planning for six counties: Hamilton, Marion, and Sequatchie in Tennessee; and Catoosa, Dade, and Walker in Georgia.

EXISTING AIR POLLUTION CONTROL PROGRAMS

The Tennessee Air Pollution Control Board is responsible for air pollution control in the State of Tennessee. This Board, established in 1967, consists of ten members, two of whom hold office ex officio, and eight of whom are appointed by the Governor. The Board has general authority to adopt rules and regulations necessary for the implementation of air pollution control within the State. During 1969 the Board adopted ambient air quality standards which establish limits upon settleable particulates, suspended particulates, soiling index, sulfur oxides measured by the West-Gaeke method, sulfur oxides measured by the lead sulfation method, and fluorides. For each pollutant the standards define four separate limits which correspond to four types of land use; industrial, commercial, residential, and recreational. The limits for industrial areas are the least stringent, and for recreational areas the most stringent. The Board has also adopted various regulations to control the emission of particulates into the ambient air. Open burning is prohibited,

with certain exceptions. Visible emissions from stacks are limited to Ringlemann number 2 for existing plants and Ringlemann number 1 for new plants. Particulate emissions from incinerators, fuel burning, and industrial processes are also limited by additional regulations. The Division of Air Pollution Control in the State Department of Public Health is responsible for implementing rules and regulations adopted by the Board. The budget for the Division jumped from about \$50,000 last year to about \$250,000 this year.

In Georgia the State Board of Health has been given authority to adopt rules and regulations necessary to implement air pollution control within the State. The Board has adopted an ambient air quality standard for sulfur dioxide pollution. The Board has also adopted various regulations to limit the emission of particulates and fluorides into the ambient air. Open burning is prohibited with certain exceptions. Visible emissions from stacks are limited to Ringlemann number 2. Particulate emissions from incinerators, fuel burning, and industrial processes are limited to varying degrees depending upon whether the plant is existing or about to be constructed. Fluoride emissions are also regulated. The Board has adopted regulations which provide for the registration of air pollution sources. The air pollution control program in Georgia has a budget of about \$311,000.

The Chattanooga Hamilton County Air Pollution Control Board has responsibility for air pollution control within the City of Chattanooga and unincorporated areas of Hamilton County. This Board has adopted an ambient air quality standard for sulfur oxides pollution. The Board has also adopted various regulations to limit the emission of particulates and sulfur oxides into the ambient air. These regulations restrict open burning, limit visible emissions from stacks to Ringlemann number 2, and regulate particulate emissions from incinerators, fuel burning, and industrial processes. Fuel with more than two percent sulfur content is prohibited. The Board may recommend revisions and additions to the rules and regulations. However, such recommendations are subject to the approval of the elected officials of the City and County. The present budget of the Chattanooga program is about \$40,000. The Board is planning to expand the budget to about \$140,000 during the next fiscal year.

The Tennessee Valley Authority conducts a program of air quality measurement and emission control in connection with its power generation and other facilities along the Tennessee Valley.

SUMMARY

In summary, the evaluation of urban factors indicates that at least three counties should be included in the

Chattanooga Air Quality Control Region; Hamilton, Walker, and Catoosa. These three counties contain essentially all of the urban, suburban and industrial development linked to Chattanooga. Urban-industrial concentrations in neighboring counties are not closely linked to Chattanooga due to the natural topographic barriers. The Chattanooga Area Regional Council of Governments, which encompasses Hamilton, Walker, and Catoosa, is well established and can provide a strong basis for regional planning in those three counties. Most of the population growth expected to occur in the Chattanooga area will be located in Walker, Catoosa, and Hamilton Counties, although Dade County may share some portion of the growth. The three counties constitute a natural regional unit for a program to control air pollution.

EVALUATION OF ENGINEERING FACTORS

INTRODUCTION

This study of the technical aspects of air pollution in the Chattanooga area was based on consideration of pollutant emissions, topography, meteorology, and measured air quality.

EMISSIONS INVENTORY

An emissions inventory is a quantitative description of emission sources broken down by geographic location and type of pollutant. The inventory usually identifies the "core" of an air quality control region; that is, the area where the bulk of the emissions occur and throughout which control activities must take place in order to deal with a regional air pollution problem. For this reason, a presentation of the emissions inventory serves as a logical starting point in the engineering evaluation.

The National Air Pollution Control Administration conducted an inventory of air pollutant emissions for the Chattanooga area. The inventory was based on estimated rather than measured emissions. The inventory applies to conditions during the year 1968. In several cases since 1968, large coal users in the area have converted their boilers to interruptable natural gas combustion with fuel oil or coal used as a standby fuel. The inventory does

not account for these changes. Three major pollutants--sulfur oxides, particulates, and carbon monoxide--were considered in this study since emissions of these pollutants provide a general measure of the location and density of air pollution sources in the Chattanooga area. Emissions from about thirty major point sources (sources emitting more than one hundred tons of any pollutant per year) were specifically listed in the inventory. The inventory encompassed three counties; Hamilton, Walker, and Catoosa. This area was divided into the grid coordinate system shown in Figure 8. The estimated emissions of each of the three pollutants were expressed by grid zone as average daily emissions on the basis of an annual averaging time. Table II shows the annual-average daily emissions.

Emission densities for each of the three pollutants, expressed in tons per square kilometer per day, were determined by relating the total emissions in each of the grid zones to the land area of that zone. Figures 9, 10, and 11 show the resulting densities on maps. Figure 12 shows the relative contribution of the various counties and various source categories to the total emissions of each pollutant.

Sulfur Oxides Emissions:

The emissions inventory indicates that about 9,000 tons of sulfur oxides gases were emitted annually by sources in the study area. About 94% of those emissions were from sources

FIGURE 8: EMISSIONS INVENTORY GRID SYSTEM

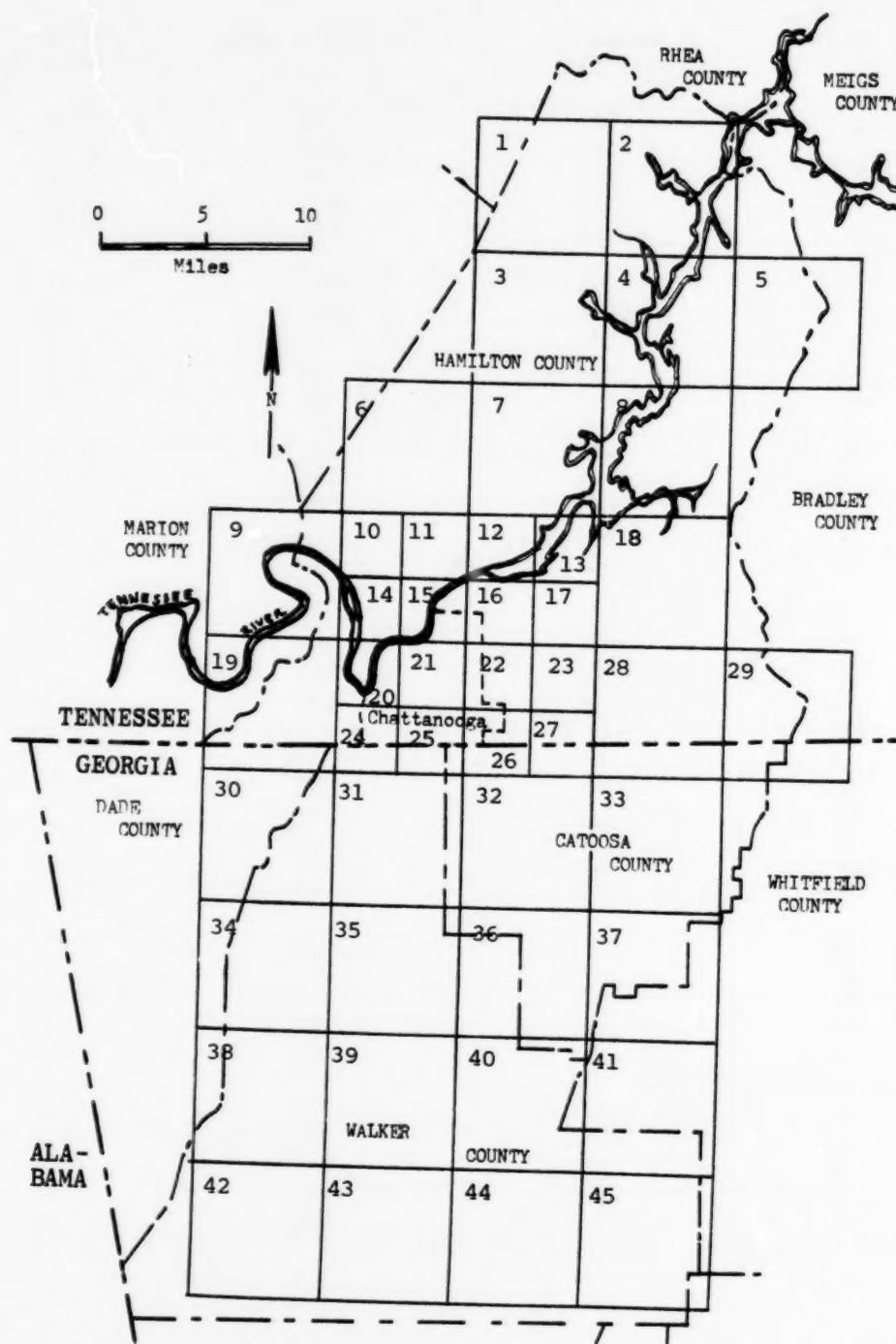


Table II

CHATTANOOGA EMISSIONS BY GRID

Tons per Day

Grid	Sulfur Oxides	Particulates	Carbon Monoxide
1	.026	.025	2.03
2	.090	.096	10.37
3	.190	.199	17.31
4	.027	.025	2.03
5	.027	.032	2.62
6	.136	.184	12.96
7	.166	.242	29.62
8	.077	.089	9.47
9	.031	.337	2.46
10	.169	1.364	17.52
11	.223	.331	51.62
12	6.119	1.194	12.28
13	.055	.084	12.61
14	3.864	4.714	69.47
15	1.434	3.741	31.74
16	.203	.188	29.97
17	2.230	24.963	42.99
18	.026	.537	.02
19	.131	.239	20.09
20	4.911	8.978	296.50
21	3.880	1.908	194.22
22	.318	1.810	85.80
23	.188	.280	26.85
24	1.528	1.440	22.06
25	.773	.522	48.89
26	.261	.303	28.76
27	.050	.057	5.14
28	.201	.274	44.94
29	.011	.017	1.90
30	.021	.020	1.06
31	.441	.512	11.23
32	.180	.226	16.14
33	.160	.210	14.02
34	.049	.039	2.14
35	.075	.190	1.15

CHATTANOOGA EMISSIONS BY GRID, Continued;

Grid	Sulfur Oxides	Particulates	Carbon Monoxide
36	.042	.034	1.69
37	.007	.008	.08
38	.020	.018	.79
39	.205	.267	5.70
40	.046	.037	2.06
41	.000	.000	.22
42	.012	.009	.46
43	.051	.038	1.76
44	.025	.018	.32
45	.028	.019	.72

FIGURE 9: SULFUR OXIDES EMISSIONS

Tons Per Square
Kilometer Per Day

TOTAL EMISSIONS: 8,968 tons per year.

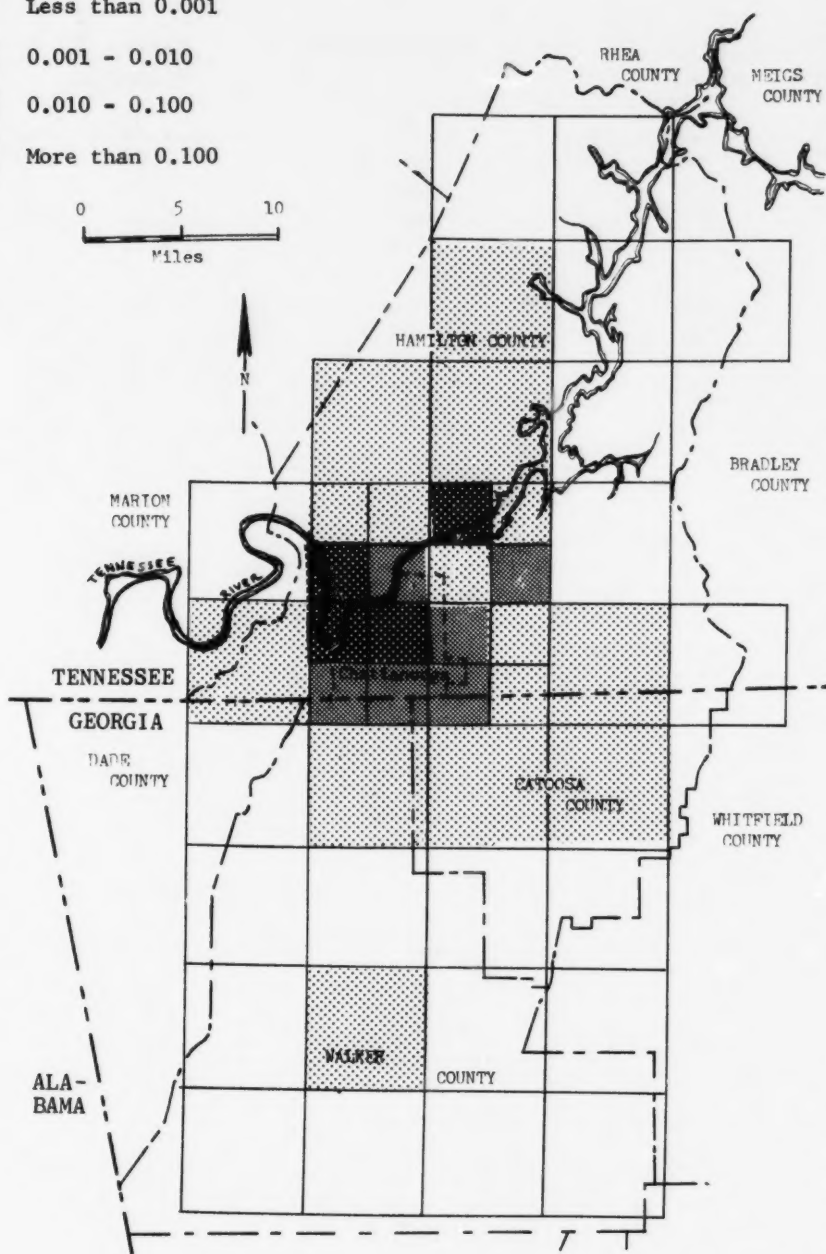
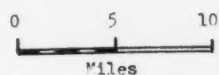
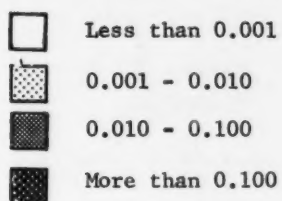


FIGURE 10 : PARTICULATE EMISSIONS

Tons Per Square
Kilometer Per Day

TOTAL EMISSIONS: 19,548 tons per year.

-  Less than 0.001
-  0.001 - 0.010
-  0.010 - 0.100
-  More than 0.100

0 5 10
Miles

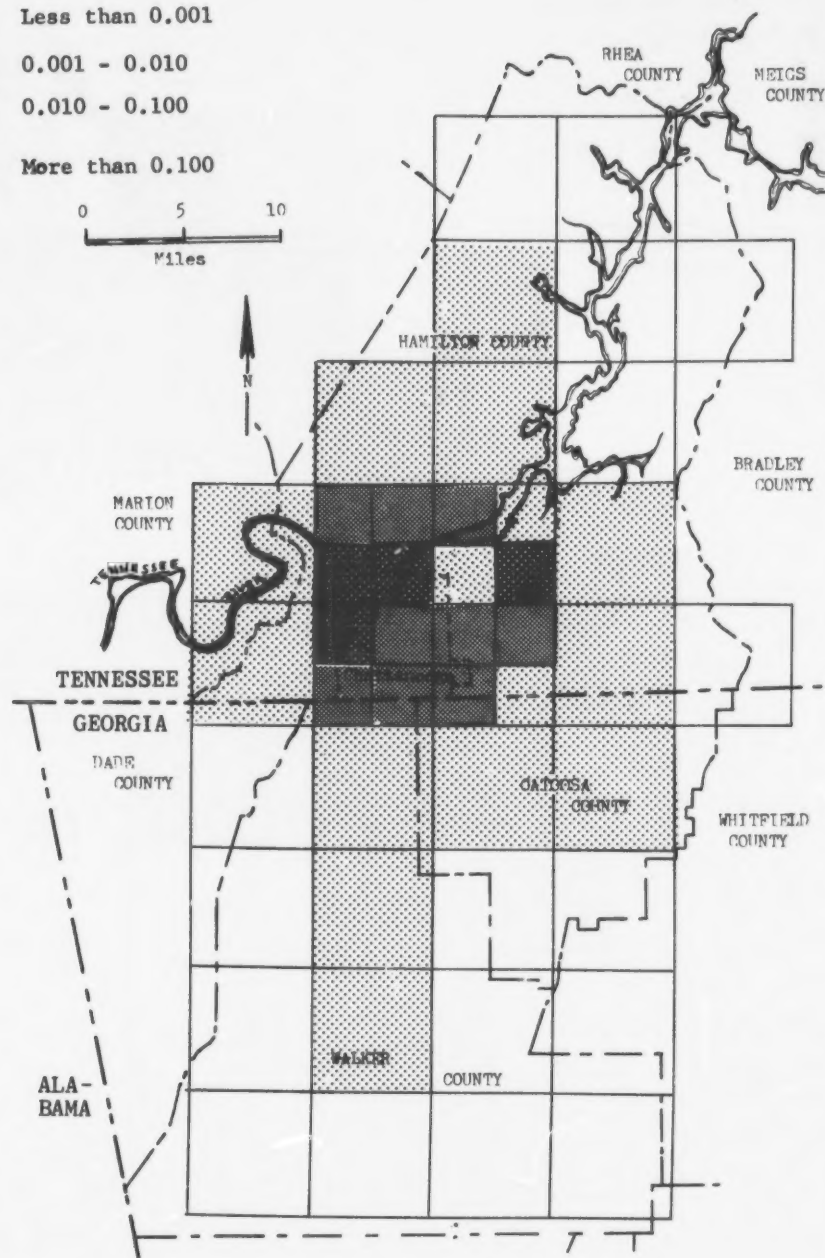


FIGURE 11: CARBON MONOXIDE EMISSIONS

Tons Per Square
Kilometer Per Day

TOTAL EMISSIONS: 433,567 tons per year.

-  Less than 0.01
-  0.01 - 0.10
-  0.10 - 1.00
-  More than 1.00

0 5 10
Miles

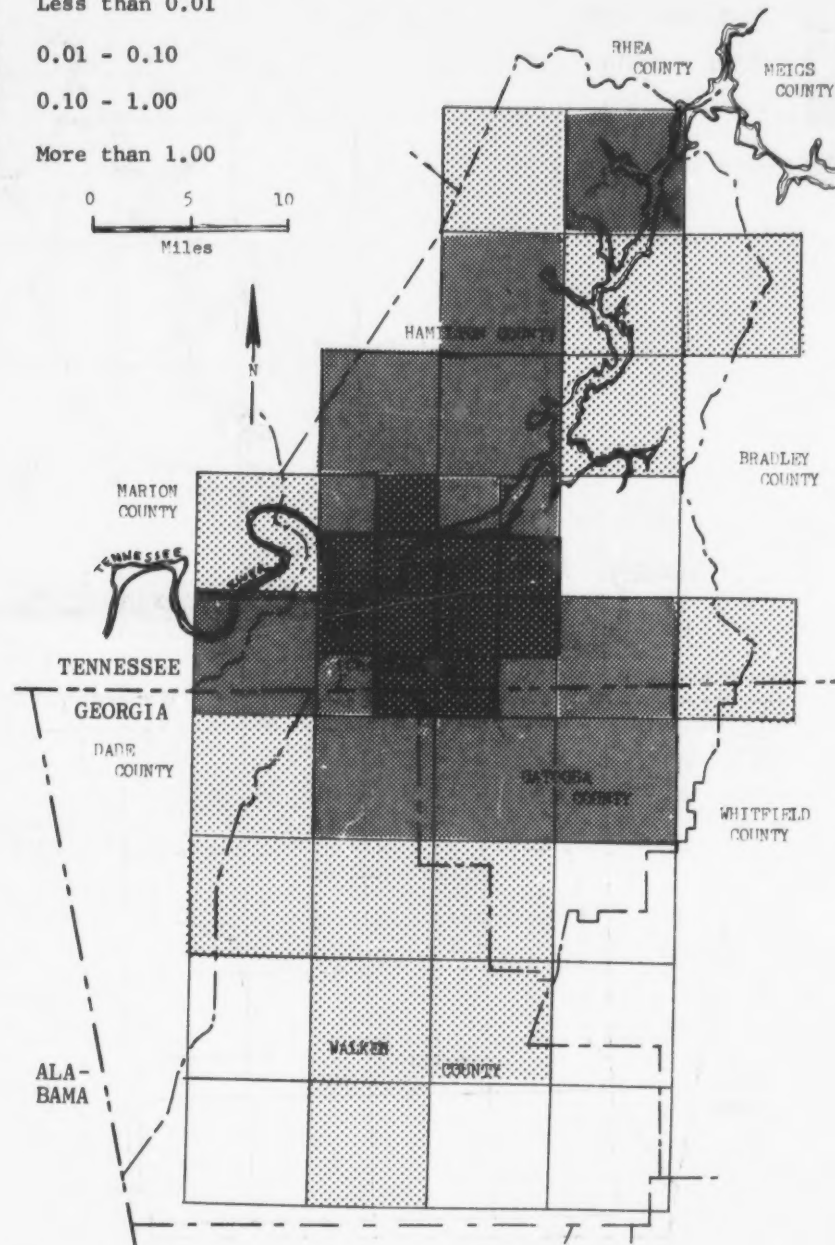
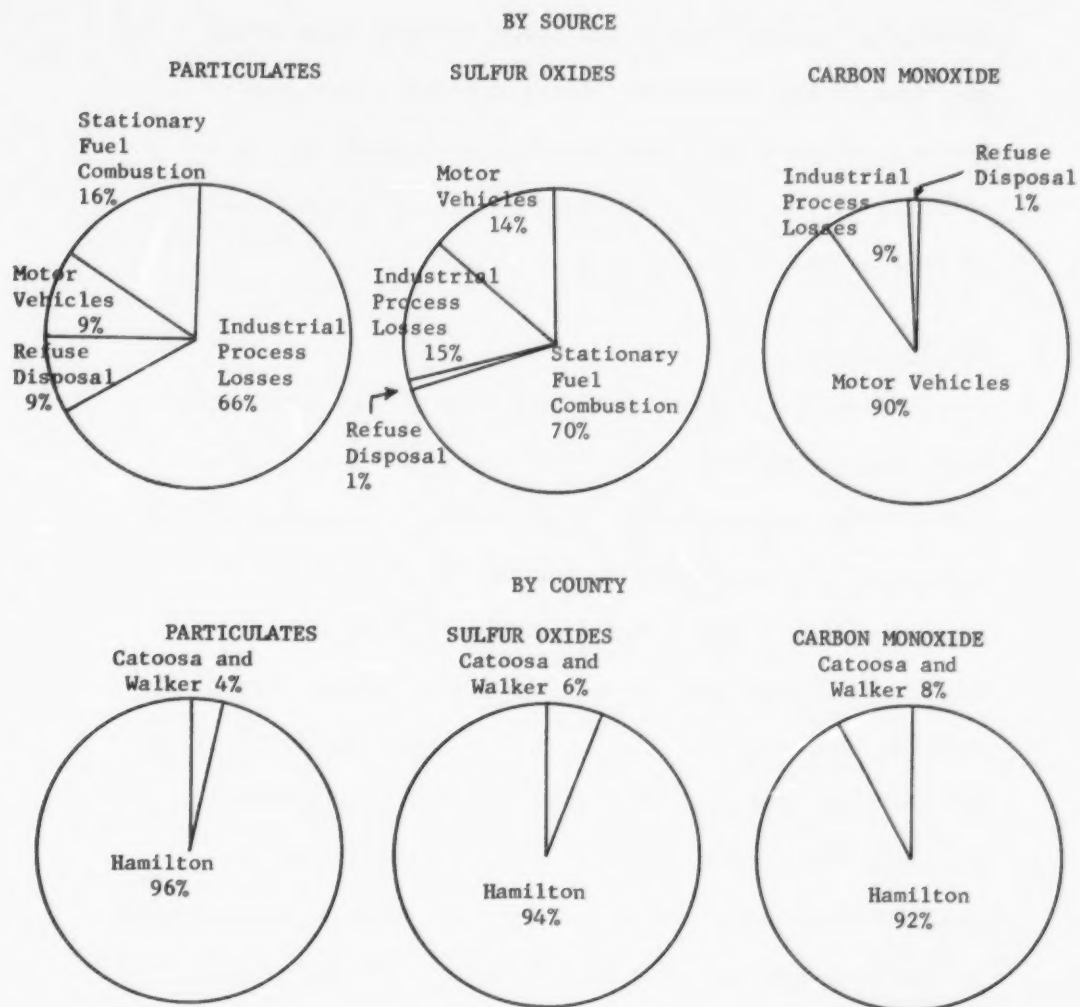


Figure 12:

RELATIVE CONTRIBUTIONS TO EMISSIONS
BY SOURCE AND BY COUNTY



in Hamilton County. Stationary source fuel combustion was responsible for about 70% of the emissions, with industrial process losses and motor vehicles accounting for most of the remainder. Emissions were found most densely concentrated along the Tennessee River in the vicinity of the City of Chattanooga and to the northeast of Chattanooga.

Particulates:

Estimates of particulate emissions in the study area were slightly greater than 19,500 tons per year. About 96% of these emissions were from sources in Hamilton County. Industrial process losses accounted for about 66% of the emissions. By far the largest source in this category was the Volunteer Army Ammunitions Plant, which emitted sulfuric and nitric acid mists. Stationary fuel combustion was the next most important source category, responsible for about 16% of the total emissions of particulates. Figure 10 shows that emissions were most densely concentrated along the Tennessee River in the vicinity of Chattanooga, and in the area of the Volunteer Army Ammunitions Plant.

Carbon Monoxide Emissions:

The emissions inventory reveals that about 433,500 tons of carbon monoxide were released in the study area each year.

About 92% of these emissions were estimated to come from sources located in Hamilton County. Motor vehicles were responsible for about 90% of the carbon monoxide emissions. Industrial process losses, especially from uncontrolled foundries, accounted for most of the remainder. Since automotive traffic was most dense in the City of Chattanooga, the most dense concentrations of carbon monoxide emissions were located there.

TOPOGRAPHY

The emissions inventory, presented above, identifies the location and amount of air pollution emissions in the Chattanooga area. This section on topography and the following two sections on meteorology and air quality will consider the geographic extent of the regional air pollution problem resulting from the transport of pollution from source locations to neighboring areas.

The topography of the Chattanooga area was mentioned above in connection with its impact upon the location of residential and industrial development. The most striking topographic features are the ridges, which are aligned along a northeast-southwest axis. The downtown business section of Chattanooga is about 650 to 700 feet above mean sea level. The ridges rise to 2,400 feet above sea level in some places. Thus, the difference in elevation amounts to about 1,700 feet in some areas. Walden Ridge

and Sand Mountain create a barrier between the Sequatchie Valley and Chattanooga. Dalton and Cleveland are separated from Chattanooga by the Taylor Ridge and White Oak Mountain. The wind roses presented in the next section will show that topography has a dominating influence over the prevailing wind direction. Winds tend to follow the valleys by blowing from the southwest and from the northeast. Furthermore, the ridges tend to interfere with the wind flow, causing reduced wind speeds in the valleys. The valleys in turn promote stable temperature inversion conditions, and inhibit the break-up of ground fog. Thus, the topography of the area tends to prevent the transport of pollution across the ridges and to aggravate the accumulation of pollutants in the Valley areas. In particular, the ridges tend to limit any interchange of pollution between industrialized portions of the Sequatchie Valley and Chattanooga, or between Chattanooga and the valley containing Dalton and Cleveland. In other words, the ridges tend to prevent pollutants generated in the Chattanooga area from having an impact upon areas outside of Hamilton, Walker, and Catoosa Counties.

METEOROLOGY

Meteorological factors influence the transport and the dispersion of air pollution. Four variables are of interest for this discussion; wind direction, wind speed, temperature

inversion frequency, and prolonged stagnation frequency. Wind direction and speed have been measured for a number of years at Lovell Field and at the Volunteer Army Ammunitions Plant. During 1967 the National Air Pollution Control Administration recorded additional measurements from stations on Lookout Mountain, on the valley floor in Rossville, atop a twelve-story building in downtown Chattanooga, and in a shallow valley just south of the Volunteer Army Ammunitions Plant. Figures 13, 14, and 15 show selected wind roses for the Chattanooga area. Recording thermometers and tether sonde data were used to calculate the frequency of temperature inversions in the Chattanooga area. Prolonged stagnation periods have been recorded beginning in 1960. The following discussion is based on these data.

Wind Direction:

The wind roses show the impact of the valleys upon wind direction. Winds measured within the valleys (Figures 13 and 14) are generally more frequent from southerly and northerly directions than from other directions. In contrast, winds measured on top of Lookout Mountain (Figure 15) occur more uniformly from all directions. Since the wind within the valley has a more direct impact upon the direction of pollution transport than higher level winds, it is clear that pollution tends to be transported up and down the valley rather than across ridges.

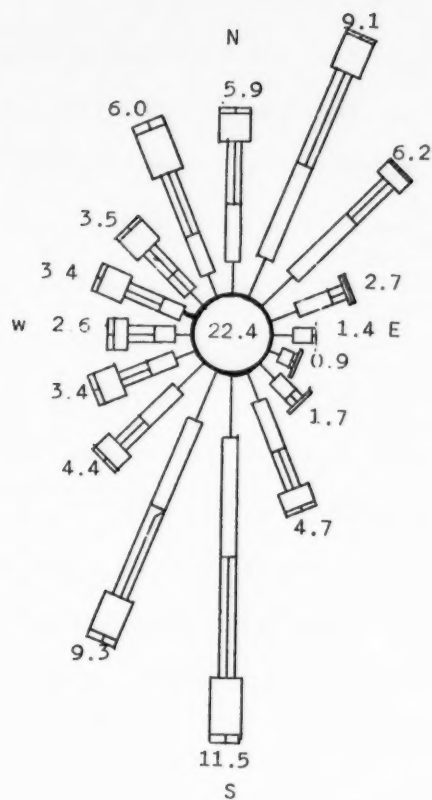
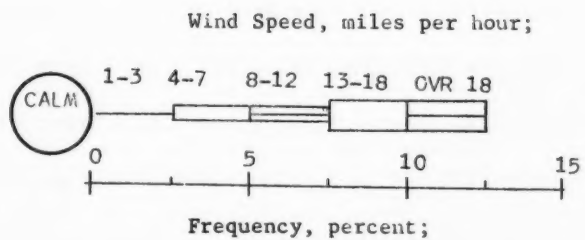


Figure 13;

FREQUENCY OF WIND DIRECTION
AND SPEEDLovell Field
Annual Average

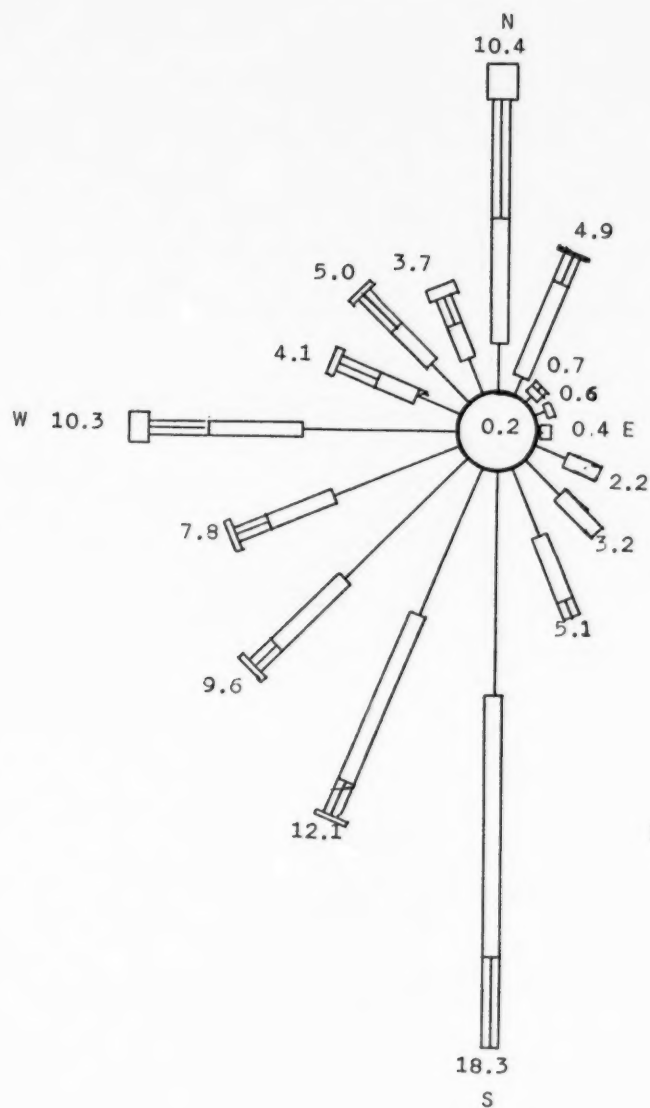
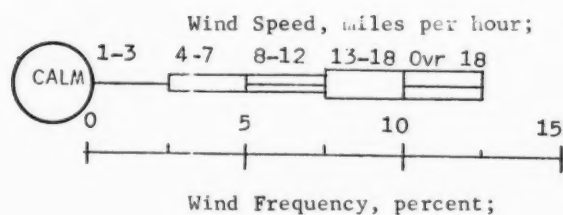


Figure 14:
FREQUENCY OF WIND DIRECTION
AND SPEED

Rossville, Georgia
Spring Average



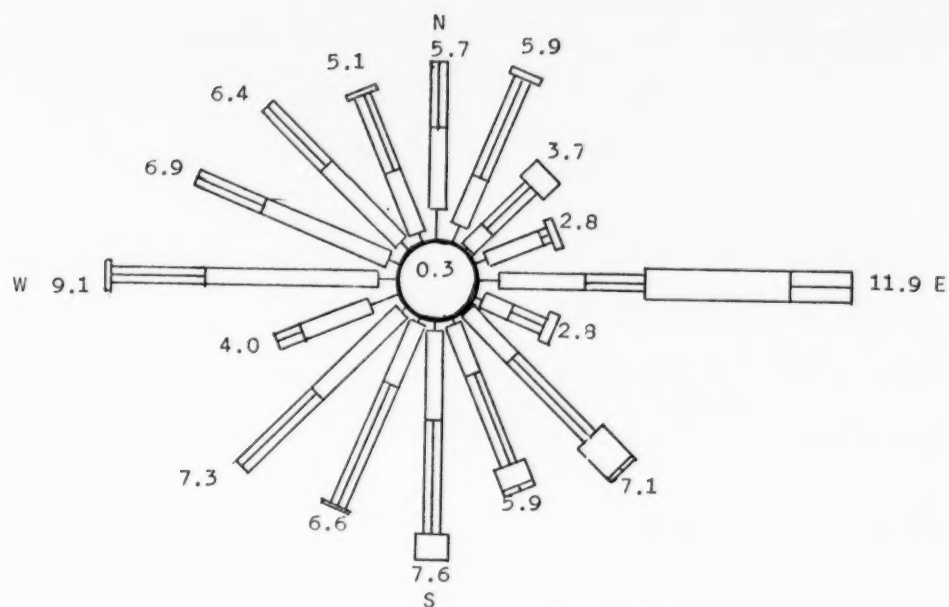
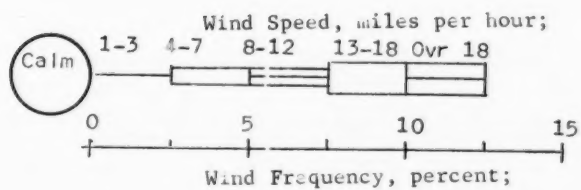


Figure 15:

FREQUENCY OF WIND DIRECTION
AND SPEEDLookout Mountain
Fall Average

Wind Speed:

The wind roses also demonstrate the impact of the valleys upon wind speed. Within the valley the frequency of wind speeds less than three miles per hour is large. In fact, the wind speed was reported as "calm" nearly one quarter of the time at Lovell Field. In contrast, the wind speed measured on Lookout Mountain was generally from four to twelve miles per hour. Thus, the wind roses indicate that pollution generated within the valley tends to accumulate rather than be carried away by strong winds.

Temperature Inversions:

A temperature inversion tends to restrict vertical movements in an air mass and thus limit the opportunity for dispersion of air pollution. Typical temperature inversions are created by radiation cooling of the land in the nighttime, and dissipated by radiation heating during the day. Chattanooga appears to have temperature inversion conditions as frequently as 40 or 50 percent of the nights during some months. A typical inversion may last for about eight hours out of a twenty-four hour period. It is clear that these inversions promote the short-term accumulation of air pollution by limiting the possibility for vertical dispersion.

Prolonged Stagnation:

Prolonged periods of temperature inversion and low wind speed allow prolonged accumulation of air pollution in the

ambient air in the vicinity of emission sources. Such stagnation periods have been recorded during the last ten years. Chattanooga lies in an area which experiences these stagnation periods more frequently than any other area in the Eastern United States except southwestern West Virginia.

Summary:

In summary, the meteorology of the Chattanooga area tends to aggravate the air pollution problem. Calm winds, temperature inversions, and prolonged stagnation periods inhibit the transport or dispersion of pollution away from emission sources in the valley. Transport of pollution from one valley to another is restricted by the ridges.

AIR QUALITY ANALYSIS

The above sections on topography and meteorology have indicated in general terms that pollution generated in the Chattanooga area tends to remain within that valley rather than travel across the ridges into neighboring valleys. This section will review available air quality measurements for the Chattanooga area. For previous urban areas subject to designation as air quality control regions, a diffusion model has been customarily employed to predict long-term concentrations of pollutants in the ambient air. The reliability of the model is questionable in areas which have uneven terrain. For this reason, the diffusion model has not been used in this analysis of air quality in the Chattanooga area.

During twelve months of 1967 and 1968 the National Air Pollution Control Administration operated a number of air quality monitoring stations in the Chattanooga area. Figures 16, 17, and 18 are based on data from these stations and other stations operated by the Chattanooga-Hamilton County Air Pollution Control program and by the State of Georgia Public Health Department. Dustfall (Figure 16) was measured at a total of 32 locations. Suspended particulates (Figure 17) were measured at a total of 26 locations. Sulfur oxides (Figure 18) were measured at a total of 10 locations.

The Figures show that the highest concentrations of pollutants in the ambient air occur in those areas where the emissions were most densely located, as shown by the emission inventory. Furthermore, Missionary Ridge appears to have some influence on the pattern of air quality by separating the Volunteer Army Ammunition Plant area from downtown Chattanooga. Although only a few monitoring stations were located in peripheral areas, they appear to indicate that the poor air quality caused by emission sources in the Chattanooga area does not extend past the three-county area of Hamilton, Walker, and Catoosa.

SUMMARY

The emissions inventory demonstrates that the bulk of emission sources in the Chattanooga area are located in Hamilton County. The discussion of topography and meteorology

Figure 16:

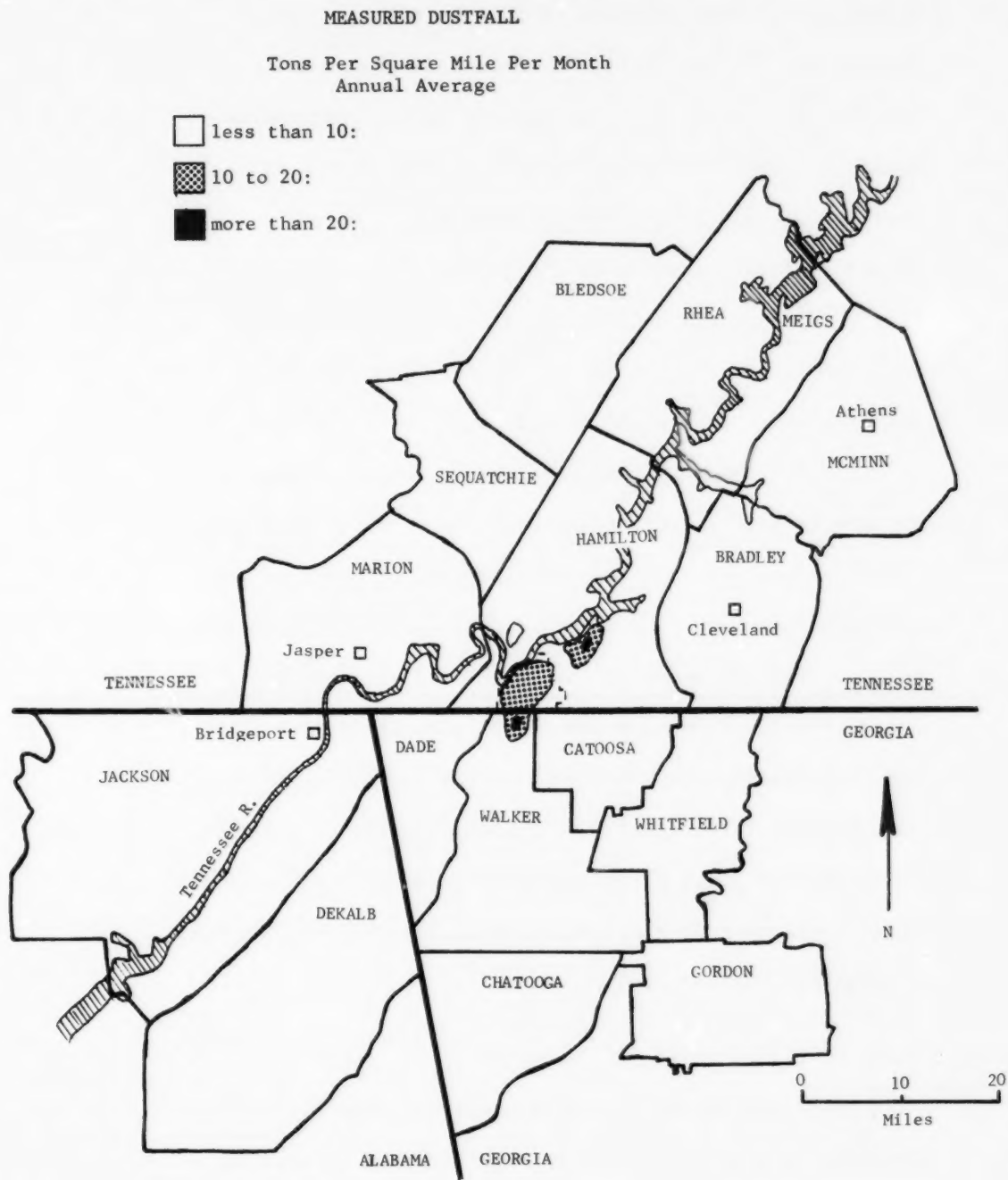


Figure 17:

MEASURED SUSPENDED PARTICULATES

Micrograms Per Cubic Meter
Annual Average

- less than 60:
▨ 60 to 100:
■ more than 100:

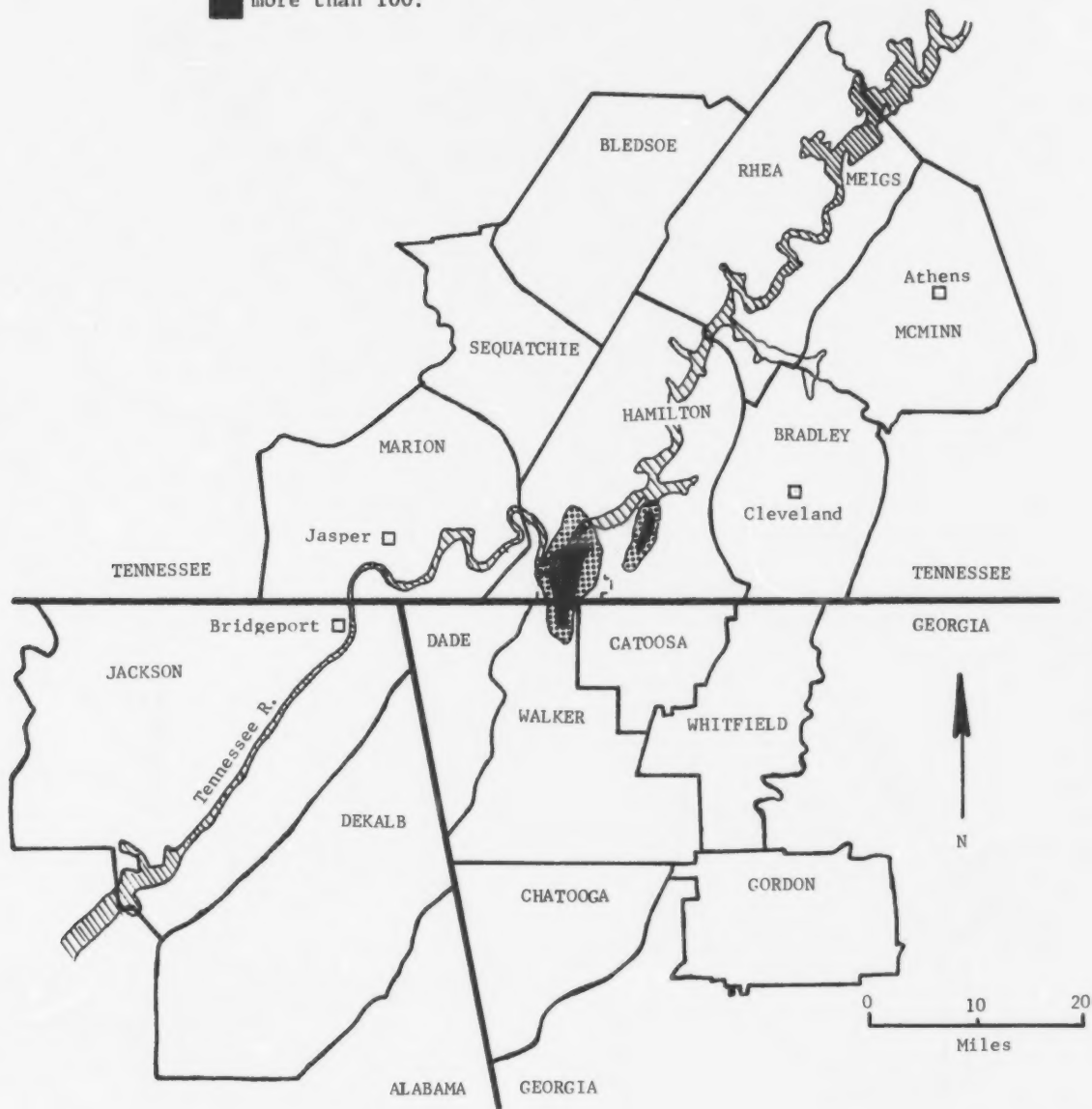


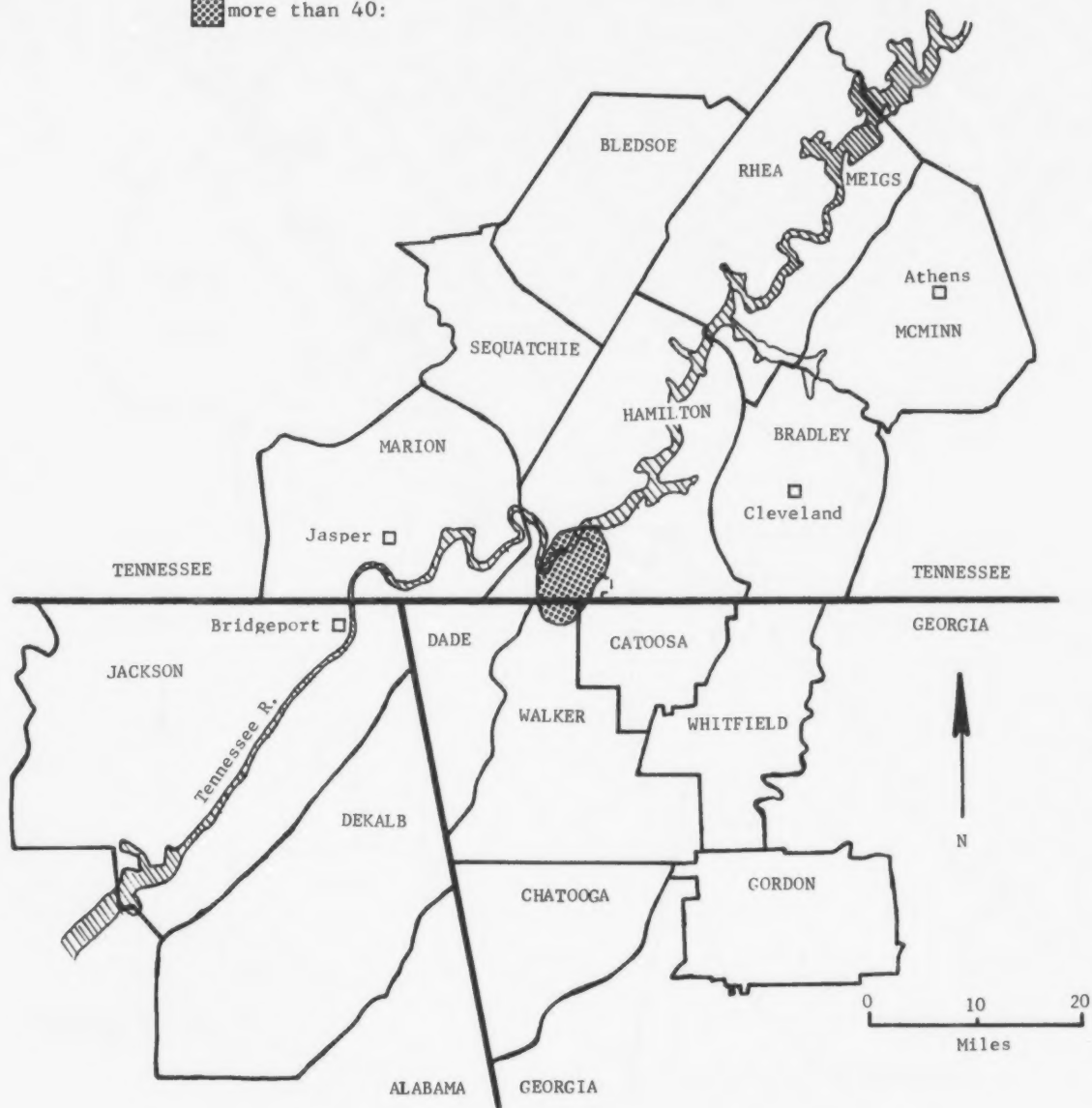
Figure 18:

MEASURED SULFUR OXIDES

Micrograms Per Cubic Meter
Annual Average

□ less than 40:

▣ more than 40:



indicates that pollution generated in the Chattanooga area tends to remain in that area rather than cross the ridges into neighboring valleys. Thus, pollution sources in Hamilton County have their primary impact upon portions of three counties: Hamilton, Walker, and Catoosa. Available air quality measurements appear to confirm this conclusion.

THE PROPOSED REGION

PROPOSAL

Subject to the scheduled consultation, the Secretary, Department of Health, Education, and Welfare proposes to designate an air quality control region for the Chattanooga area, consisting of the territory encompassed by the following jurisdiction:

In the State of Tennessee:

Hamilton County

In the State of Georgia

Catoosa County

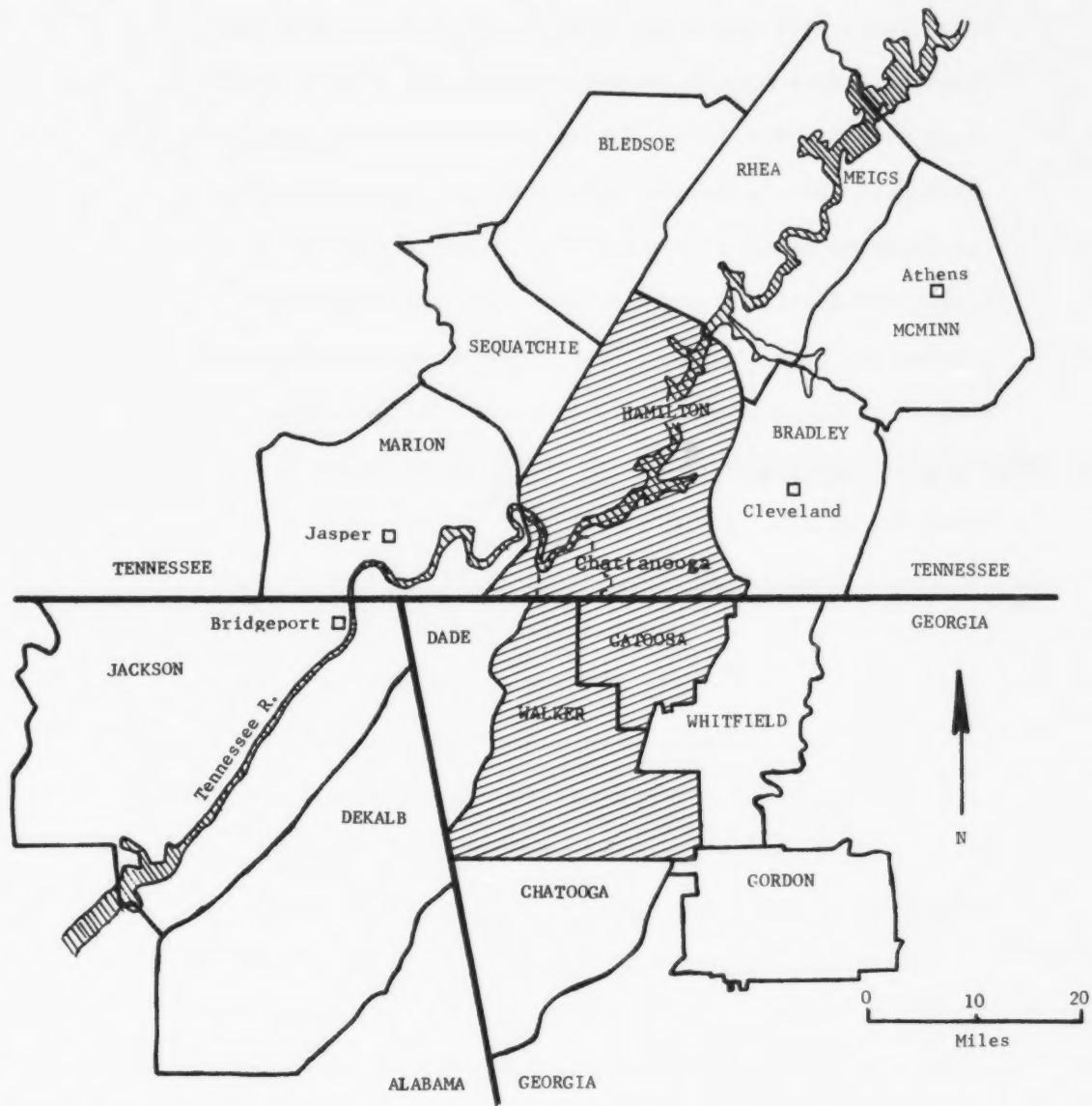
Walker County

The boundaries of the proposed region are illustrated in Figure 19.

DISCUSSION OF PROPOSAL

To be successful, an air quality control region should meet three basic objectives, as discussed in the section entitled "The Size of a Region," page 9. First, a region should be self-contained with respect to air pollution sources and receptors. Second, a region should be designed to meet not only present conditions but also future conditions. Third, region boundaries should foster unified and cooperative governmental administration of the air resource throughout the region.

Figure 19:
PROPOSED CHATTANOOGA INTERSTATE AIR QUALITY CONTROL REGION



The evaluation of urban factors revealed that all of the urban, residential, and industrial development linked to Chattanooga is contained by three counties: Hamilton, Catoosa, and Walker. Although significant urban-industrial concentrations are found in neighboring counties, these centers of activity are not closely related to Chattanooga and do not depend upon Chattanooga for their existence. Population and industrial growth connected to the Chattanooga area is expected to occur primarily in Walker and Hamilton Counties, with some spillover into Catoosa and Dade Counties. The Chattanooga Area Regional Council of Governments, which is responsible for many regional planning functions in the area, encompasses Hamilton, Walker, and Catoosa.

The evaluation of engineering factors indicated that the bulk of emissions surveyed were from sources in Hamilton County. Due to the topography and meteorology of the area, it appears that emissions from sources in Hamilton County tend to remain in the valley areas around Chattanooga. There appears to be only limited transfer of these emissions into valleys which are separated from Chattanooga by ridges.

Therefore, the proposal for a three-county air quality control region appears to satisfy the objectives mentioned above. However, it should be recognized that the proposal rests upon partial information. The emissions inventory

did not consider sources in counties other than Hamilton, Catoosa, and Walker. The air quality monitoring system was not extensive enough to rule out decisively any possibility of pollution interchange between Chattanooga and the Sequatchie Valley. If further study of the air pollution problem in the Chattanooga area reveals that additional counties are closely involved, they should be reconsidered for inclusion in the Region.

The boundaries proposed in this report for the Chattanooga Interstate Air Quality Control Region area are a starting point for discussion with State and local authorities at the scheduled consultation.